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The Climate of Alachua County, Florida

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This publication was promulgated at an annual cost of $1440.55 or a cost of 36 cents per copy to provide a source of basic climatic data for persons concerned with resource and environmental problems.

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ABSTRACT

An inventory of sources of meteorological data for Alachua County is presented. Climatic data for the county is presented, the local climatic patterns are discussed, and these patterns are related to the zonal and local behavior of the atmosphere. Important properties of the local climate are related to problems of pollution, and health.

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INTRODUCTION

The local climate of an area is the product of the interaction of the zonal properties of the atmosphere with the surface features and properties characteristic of that area. Regional topography and land-water distributions play important roles in the determination of the patterns of variation in the climatic elements of a particular locale. Although northcentral Florida is a relatively homogenous region geographically, Alachua County differs from the counties surrounding it in latitudinal location, distance from the sea, and in the percentage composition and distribution of types of surface features. It is these differences which let us discuss the climate at Alachua County as a distinct entity.

Climatology is the study of climate. It explains the normal behavior of atmospheric phenomena by means of physical principles, often with emphasis on atmospheric behavior at specific points on the earth's surface. According to Stringer (1972) there are three basic approaches to climatology. The first is the presentation of climatic data. The second is the explanation of climatic data in terms of physical principles. The third is the application of analyses of climatic data to human problems whenever possible. All of these approaches to climatology depend upon the availability and acquisition of climatic data. Any climatological study is only as good as the excellence of its data, so it is logical to begin this report with an appreciation of the sources of climatic data for the county.

DATA SOURCES

One of the best sources of climatic data for the Gainesville area is the CAA meteorological facility at the Gainesville Airport. Hourly wind, temperature, humidity, pressure, and general observations are available from this station. These data may be obtained as microfilm copies from the National Weather Records Center at Asheville, North Carolina.

There are three United States Weather Bureau Climatological stations within Alachua County. One of these is located at the University and is discussed below. The other stations are located at High Springs and Island Grove. The High Springs station collects temperature, freeze, and precipitation data. The station at Island Grove collects precipitation data only. These data are reported monthly and annually in the National Oceanic

and Atmospheric Administration's (NOAA) serial publication, *Climatological Data*. Another NOAA publication (J. T. Bradley, 1972), provides general insights into the patterns of Florida climate which apply to the county.

The Forestry Department of the State of Florida collects precipitation data at five locations within the county: La Cross, Micanopy, Hawthorne, Gainesville, and a fire tower on Highway 41 between Archer and Newberry. The station in Gainesville also makes daily temperature, humidity, and the more specialized fuel moisture observations. The local division of the Forestry Department is responsible for a four-county region and maintains stations at Starke and at Hollister on Highway 20 which make the same daily observations as at the Gainesville stations.

The Regional Utilities Board (RUB) maintains weather sensors at their Kelley plant in Gainesville and at the Deerhaven plant on Highway 441 north of Gainesville. The RUB plans to instrument a 1,000-foot television mast near the Devil's Millhopper with temperature and wind sensors, in cooperation with the County Pollution District. Data obtained from this tower will constitute an important contribution to the understanding of local climate within the county, and they will be quite valuable for application to problems of air pollution.

One of the richest and most useful sources of local meteorological and climatic data is the University of Florida. There are several campus organizations which collect data, either on a routine basis or for special studies. One of the most important of these is the Institute of Food and Agricultural Science's (IFAS) Climatological Station at the campus agronomy farm. This unit reports to the NOAA Weather Data Center and also publishes its observations in the form of a monthly data sheet. Air temperatures and precipitation data from the Beef Research Unit, located some three miles to the north of the Gainesville Municipal Airport, are also reported in this data sheet. The data included from the agronomy farm are: daily values of maximum and minimum temperatures, minimum relative humidities, precipitation, soil temperature at 10 cm depth, pan evaporation, and daily wind run. The data sheets may be obtained from Dr. Gordon Prine of IFAS (Agronomy Department, 1969-1975).

Another valuable IFAS climatic data source is the Climatological Laboratory at the University's Horticulture Unit. The laboratory, under the direction of Dr. J. Bartholic, specializes in freeze protection. In addition, it collects data on a routine basis and is the site of other, very sophisticated microclimatological investigations.

The School of Forest Resources and Conservation has recently established a climatic station at the Austin Cary Forest (October, 1975). This station collects wind vector, solar and net radiation, pressure, air temperature, relative humidity, evaporation, soil temperature, soil moisture tension, and depth to water table data on a routine basis. In addition, the station is to serve to supplement observation programs in forest microclimatology and hydrology. Information concerning the station and data availability may be obtained from Professors W. L. Pritchard or W. H. Smith.

Dr. S. Davis of the Department of Botany has unpublished information on local concentrations and distributions of airborne algae. Dr. H. Wittig of the Medical Center has collected data on allergen and antigen concentrations and distributions (Wittig, 1971).

The Interdisciplinary Center for Aeronomy and Atmospheric Sciences (ICAAS), the Department of Environmental Engineering, the Solar Energy and Energy Conversion Laboratory, the Center for Wetlands, and the School of Forest Resources and Conservation all have published and unpublished data available from special studies. None of these organizations are involved in programs of routine climatic observations at the present time.

There are very few upper air data, if any, available for the Alachua County region, and none have ever been collected on a routine basis. The nearest radiosonde or rawinsonde stations are located at Tampa and Jacksonville, and any calculations involving upper air conditions for Alachua County must use data from one or preferably both of these stations. There are indications that aircraft soundings were made in the region during the Second World War[1], but I have been unable to locate any records of these soundings.

LOCAL CLIMATIC PATTERNS

Precipitation

More than half of the average annual rainfall occurs during the months of June, July, August, and September (Fig. 1). The greatest amount falls during August which averages 208 mm. Average annual precipitation for Gainesville is 1370 mm. The month with the lowest average rainfall is November with 44 mm. Rainfall may be extremely variable from year to year, and departures from the mean precipitation of as much as 40 percent have occurred. Snow occurs lightly, irregularly, and infre-

[1]H. P. Gerrish, personal communication.

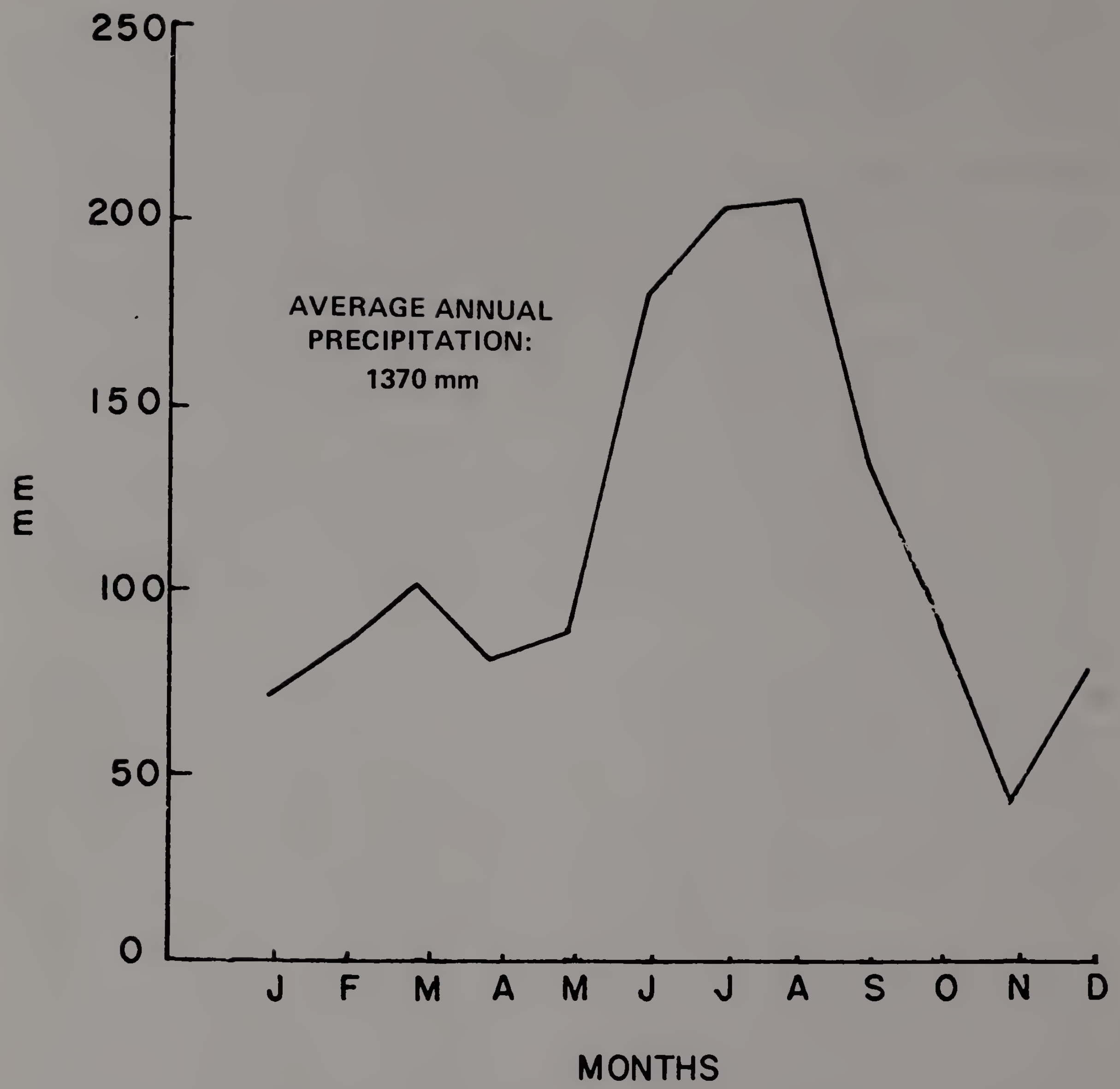

Figure 1. — Average monthly precipitation for Gainesville in millimeters (30 years record — NOAA).

quently. It may not occur as often as once every ten years, and when it does occur, it will not normally accumulate or remain in place.

Pan Evaporation

Average annual pan evaporation for Gainesville for 22 years of records is 1674 mm (Fig. 2). Monthly variation in average values follows the pattern of monthly variation in solar radiation described below. True evaporative loss is less than the recorded pan evaporation, and depending upon the state of the weather and condition of the vegetation may vary from 80 percent to 20 percent of the recorded value.[2] This element varies less from year to year than does precipitation.

[2]J. F. Bartholic, personal communication.

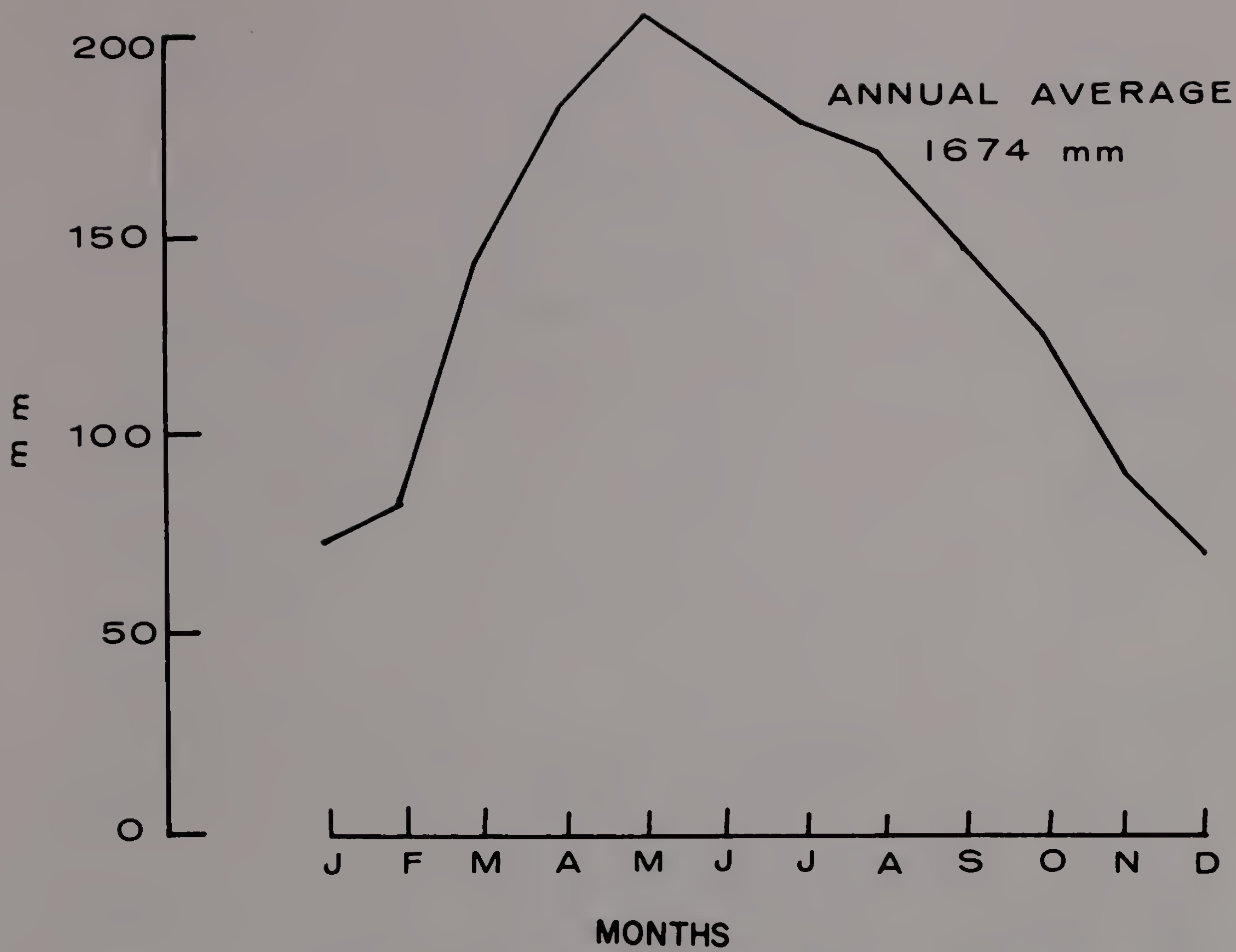

Figure 2. — Average pan evaporation for Gainesville in millimeters (22 year record, 1954-1975, IFAS).

Solar Radiation

Daily totals for solar radiation were supplied by Dr. Erich Farber of the Solar Energy Laboratory for the years 1955-1975. These data were summarized on a monthly basis, and an average value for solar radiation was obtained for each month. These values were summed to provide an estimate of average annual solar radiation. This procedure was necessary because of gaps in the data. The average annual solar radiation for the Gainesville area was 156,150 langleys (Fig. 3). May receives the greatest monthly solar radiation, and January the least. The greatest year to year variation occurs from June through October, with the strongest variation occurring in June.

Temperature

The average range in monthly temperature is about 13°C, and the average diurnal temperature variation is also about 13°C (Fig. 4). The average diurnal range is somewhat reduced during the summer months due to the depression of the average maximum temperature by afternoon cooling caused by thunder-

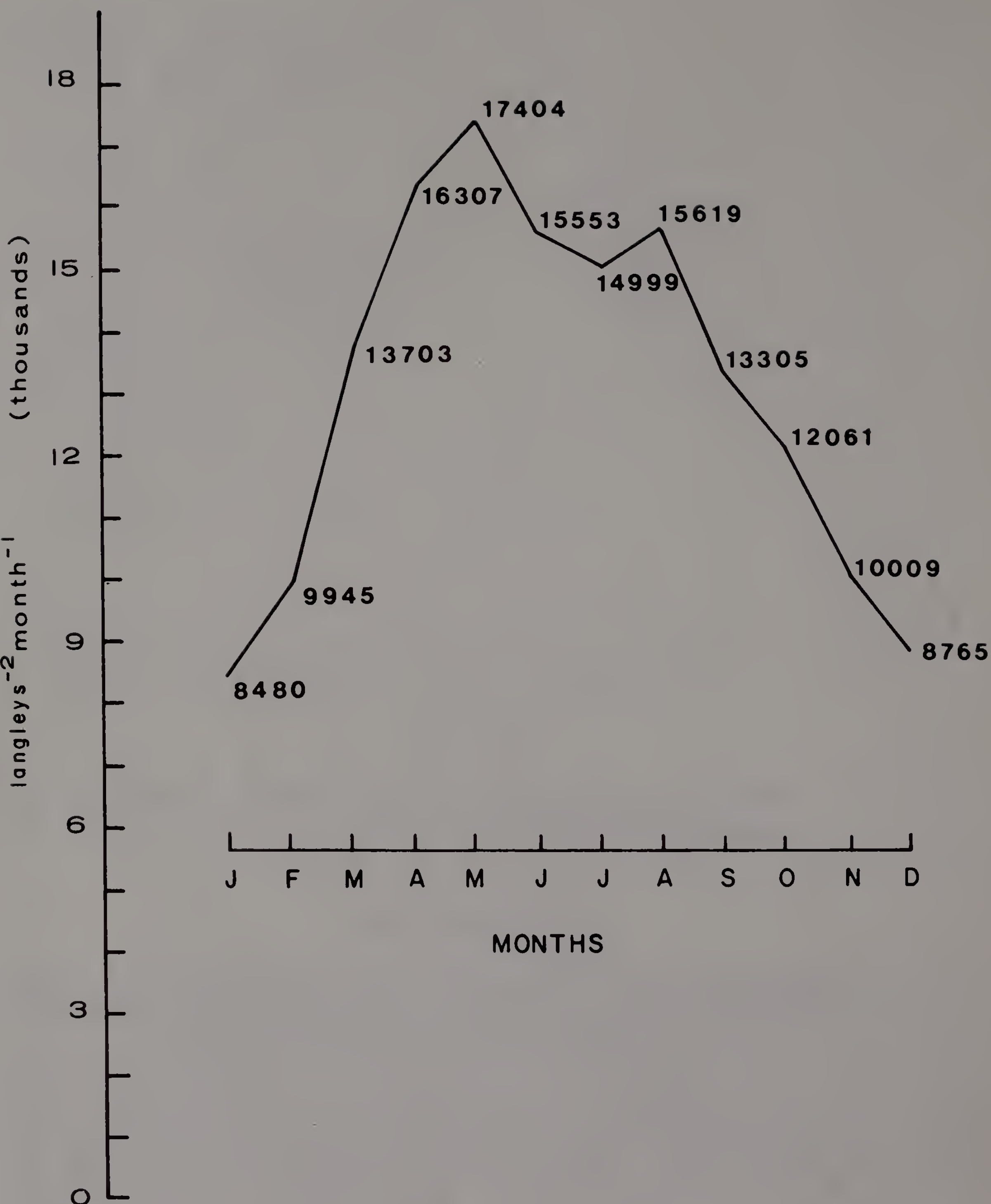

Figure 3. — Average monthly solar radiation for Gainesville in langleys (20 year record, 1955-1975, Solar Rad. Lab.).

storm activity, and by the presence of freely evaporating surfaces (Priestly, 1966). In the absence of such cooling, maximum shade temperatures may go as high as 40°C. In the winter, a temperature as low as −9°C has been recorded. This is a rare event, once in 30 years, and on the average a freeze may be expected only four times per year (Table 1). The average frost free season for Gainesville is 295 days. There is an average of 1,108 heating degree days (calculated from a base temperature

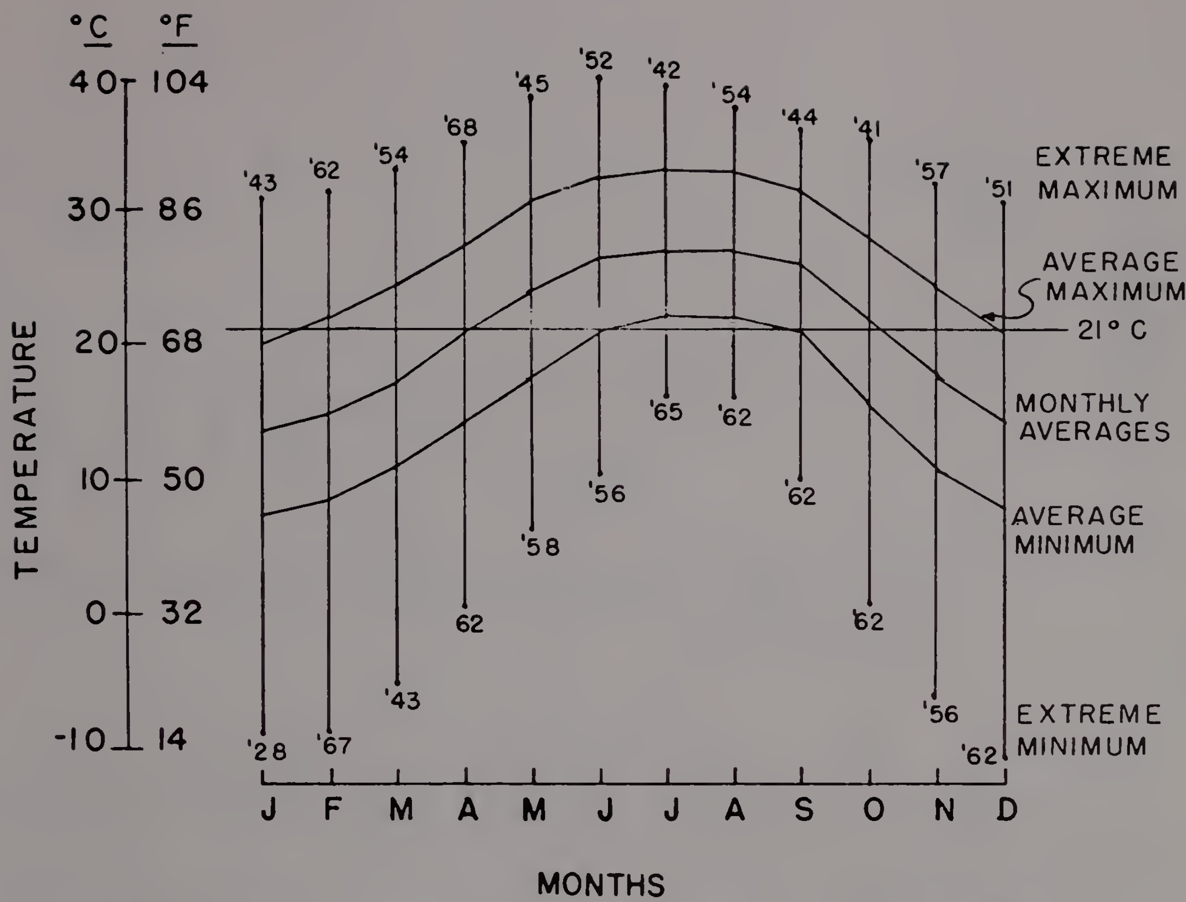

Figure 4. — Average, maximum and minimum air temperature for Gainesville in °C (30 year record, 1939-1968, NOAA). Extreme maximum and minimum temperatures shown with year of occurrence. 21°C Average Annual Temperature.

of 65°F) during the winter months, which means low average heating costs for the county and its residents (Fig. 5).

The average annual soil temperature at the 10 cm depth is 23°C (Fig. 6), and average diurnal variation runs from 4°C to 2.5°C. Average annual variation is about 16°C. The warmest month is July and the coldest is February at that depth.

Table 1.—Freeze Data (30 Year Record) — Climate of Florida.

Threshold Temperatures °C	°F	Mean Date of Last Spring Occurrence	Mean Date of First Fall Occurrence	Mean Number of Days Between Dates	Number of Occurrences Spring	Fall
0	32	2/14	12/6	295	27	21
−2.2	28	1/30	12/16	320	21	18
−4.4	24	1/8	12/26	352	9	8
−6.7	20	—	—	—	4	2
−8.9	16	—	—	—	1	1

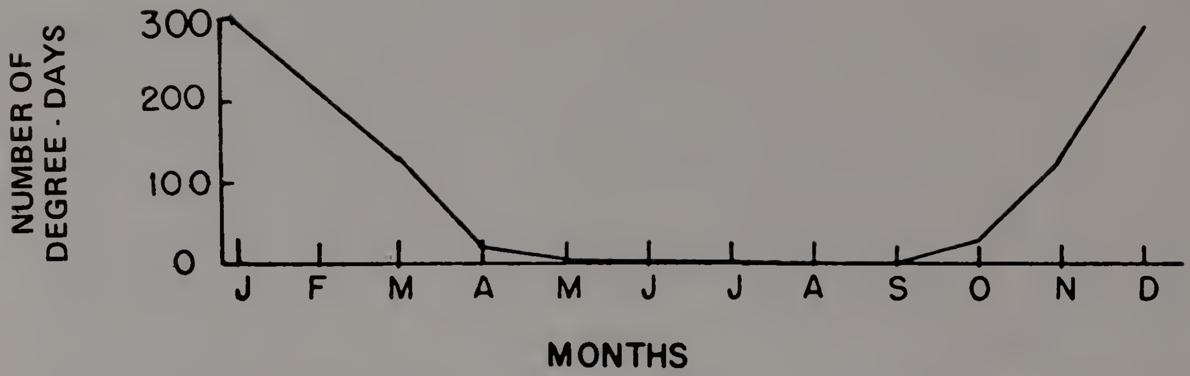

Figure 5. — Average heating degree days for Gainesville, calculated from a base temperature of 65°F (18.5°C) (15 year record, NOAA).

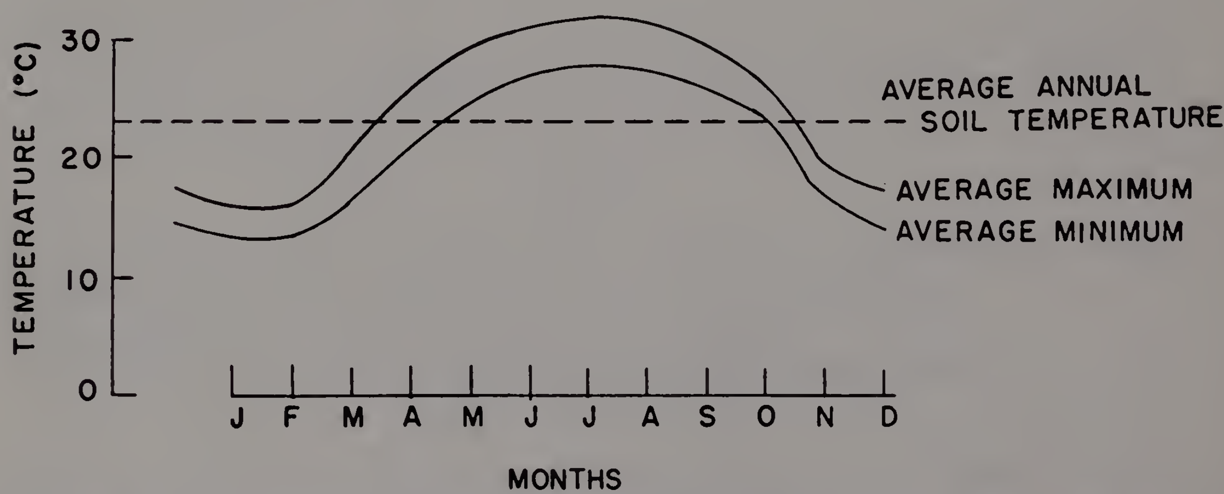

Figure 6. — Average monthly maximum and minimum soil temperatures for Gainesville for 10 cm depth under short pensacola bahia grass sod. (5 year record, 1969-1975, IFAS).

Relative Humidity

Average monthly minimum relative humidity rarely falls below 40 percent. There are a few days each summer when relative humidity remains above 70 percent. When these values coincide with high temperatures, both human and animal physiologies are highly stressed. More work needs to be done on the collection and presentation of relative humidity data for the county. Because data are presented as daily minimum relative humidities, calculations of average monthly relative humidities were not possible.

Winds, Ventilation, and Stability

Based on data from the local airport from 1970 through 1972, Alachua County is a region of light winds (Fig. 7). Ninety-five

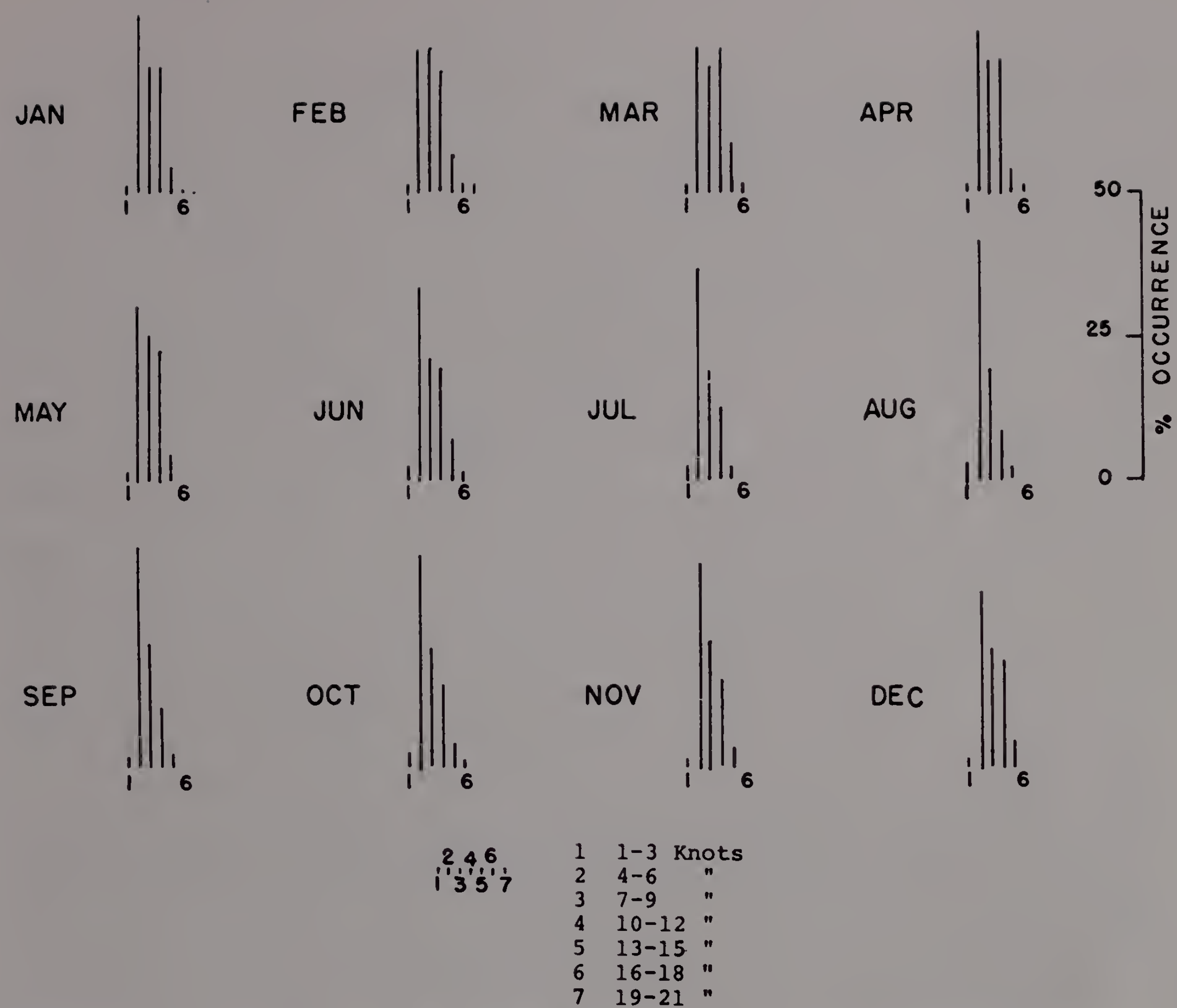

Figure 7. — Monthly wind speed distribution — Gainesville Airport (3 year record, 1970-1972, NOAA).

percent of all winds are less than 12 knots, 78 percent of all winds are less than 9 knots, 56 percent of all winds are 6 knots or less, and 22 percent of the time there is no measurable wind. The average wind speed for the three years of records analyzed was 3 knots, or 3.1 m/sec. Gusts of 40 to 50 knots, enough to cause light structural damage, were observed during the period analyzed.

There is a pronounced diurnal variation in wind speed (Fig. 8). During the winter season (October-April), nights are usually calm, with 90 percent of the winds occurring between 8 p.m. and 8 a.m. less than 3 knots. Wind speeds ordinarily reach their maximum values between noon and 4 p.m. During the summer season (May-September), there is a shorter calm period. Between 10 p.m. and 7 a.m. over 90 percent of the winds are less than 3 knots. Wind speeds may be expected to attain maximum values between 1 p.m. and 5 p.m.

An analysis of the diurnal variation in wind direction shows that the normal wind direction is from the north at night for

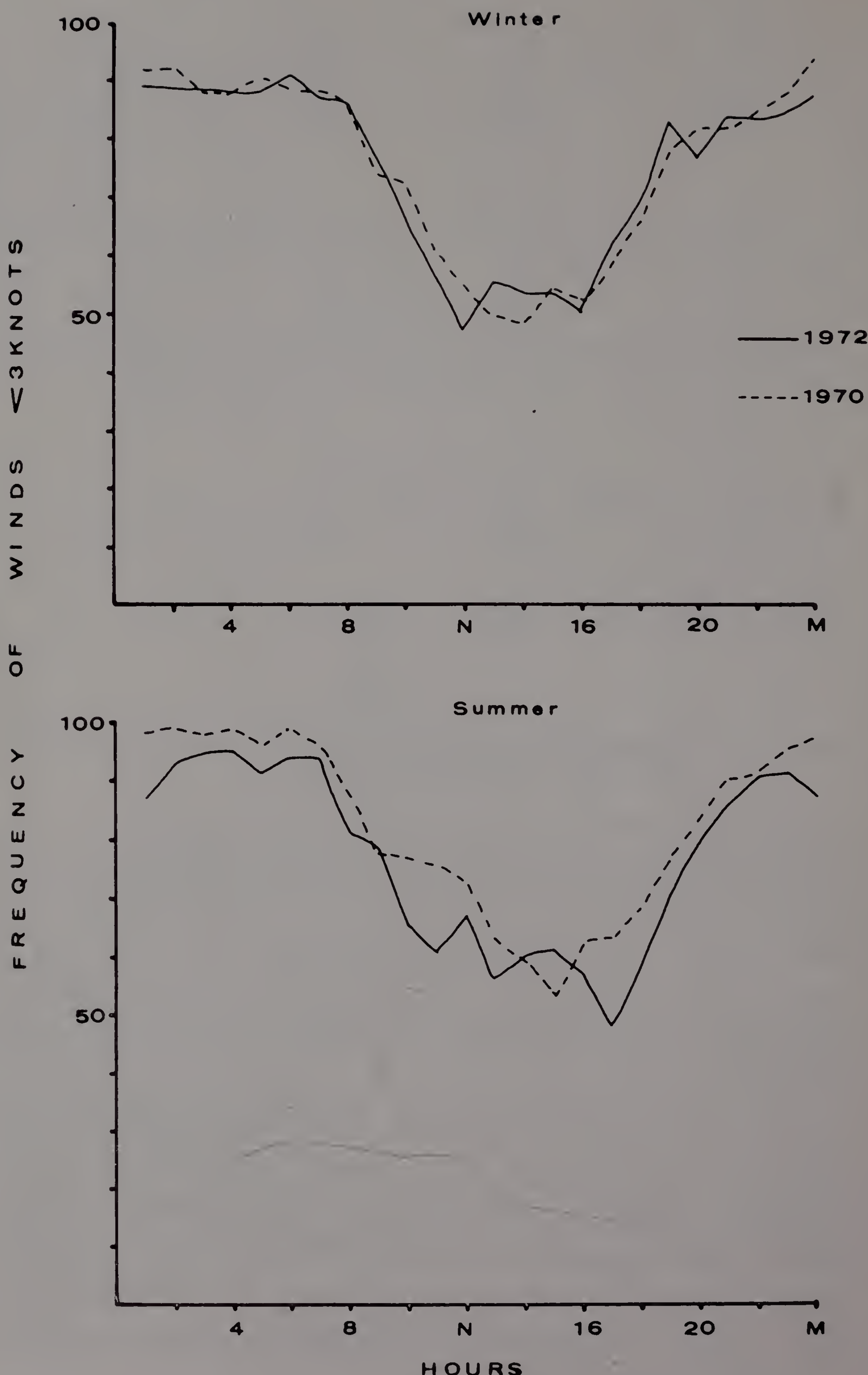

Figure 8. — Diurnal variations in wind speed — Gainesville Airport (3 year record, 1970-1972, NOAA).

the entire year. During the day, the wind is almost equally likely to occur from any direction. At night, during the summer season, the winds are least likely to come from the southwest, west, or northwest. This description is based on only three consecutive years of observations and should be regarded as indicative of the patterns of variation which may be encountered. It is not a definite description of these patterns.

Except for a slight tendency for more northerly winds during the winter months, and more westerly flow during the spring, the direction of wind flow appears equally likely from any point of the compass (Fig. 9). Subjective observations indicate that there may be a preferred direction of flow at certain times of the day. Such patterns would not be revealed by the monthly wind roses, and were not observed in the analysis of wind direction data for 1970.

Ventilation heights, the height of the column of air in which vertical mixing takes place, have been computed for Gainesville and the Alachua County region from Jacksonville and Tampa rawinsonde observations (Table 2). A maximum average height of about 1,400 meters occurs in May, and a minimum average

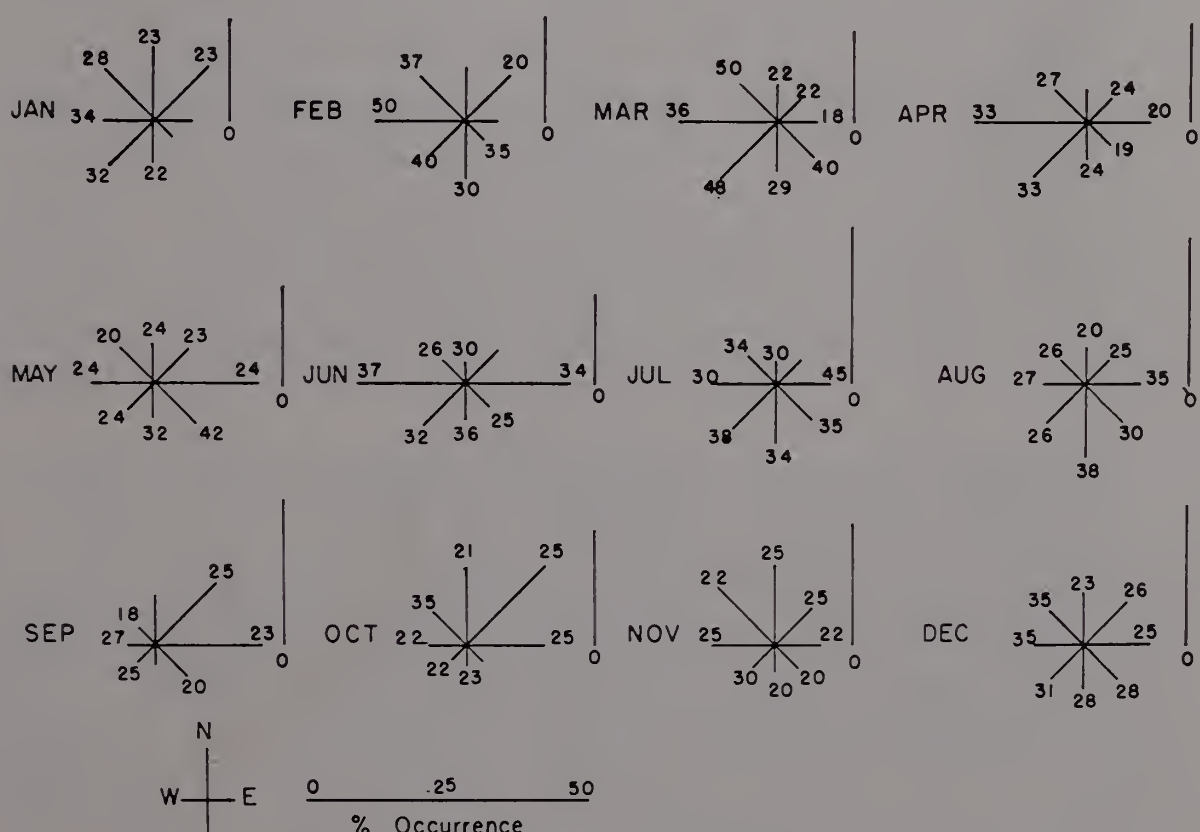

Figure 9. — Monthly distributions of wind direction — Gainesville Airport (3 year record, 1970-1972, NOAA). Numbers refer to strongest recorded gusts (knots), zero line is for calms.

Table 2.—Air Quality Data — Ventilation Capability.

Month	Mean Wind Speed (m/sec)	Mean Maximum Mixing Depth (meters)	Ventilation (m^2/sec)	Mean Seasonal Ventilation (m^2/sec)	Relative Dilution Factor
Dec	3.0	810	2430		
Jan	3.3	730	2420	2390	1.00
Feb	3.5	950	3320		
Mar	3.6	940	3380		
Apr	3.4	1310	4450	4250	1.78
May	3.5	1410	4930		
Jun	3.2	1360	4350		
Jul	2.6	1310	3400	3790	1.59
Aug	2.8	1290	3610		
Sep	2.6	1270	3300		
Oct	2.9	1290	3740	3310	1.39
Nov	2.9	1000	2900		

height of about 750 meters occurs in January. If we assume that these heights are controlled by synoptic scale phenomena, the extrapolation of Tampa or Jacksonville values probably gives a fair approximation of the true ventilation heights for the Alachua region. The weighted mean ventilation height for Gainesville based on both Tampa and Jacksonville soundings is about 1,350 meters.

Wind speeds used for the computation of ventilation in Table 2 are mean monthly wind speeds, not mean vector wind velocity. The mean vector wind velocity, unlike mean wind speeds, takes changes in the direction of motion into account. That is, it provides information concerning the true rate at which a unit volume of air will move from its point of origin. Thus, mean wind speeds for Alachua County will be larger than mean vector wind velocities, and will overestimate the ventilation capability of the atmosphere in this region.

The atmosphere of Alachua County displays a high degree of stability. Environmental Science and Engineering, Inc. has computed the annual Pasquill stability frequencies as part of a pollution study for the RUB. Their figures indicate a high degree of stability, with 71 percent frequency for stable and very stable conditions.

Gainesville has low level inversion conditions (0-150 meters height) during 40-50 perecent of the hours per day in the fall. This is an average for the period 1936-1960, and it corresponds rather well to periods of occurrance of a low-level nocturnal inversion. However, there were only 50 to 60 cases of severe stagnation occurrences (four days or more of stagnating anticyclone) for the same period (Pack, 1964). As discussed below, other mechanisms also contribute to the maintenance of a stable atmosphere above the county.

CAUSAL MECHANISMS FOR LOCAL CLIMATIC PATTERNS

There are two major sets of factors which act to determine the climatic patterns of Alachua County. The first set consists of the critical features of the surface of the county and their location in relation to the geography of the region. The second set consists of the predominant features of zonal atmospheric behavior.

In the first set, we may list: 1) latitude, 2) proximity to the Gulf of Mexico and the Atlantic Ocean, 3) presence of inland lakes, 4) strength of surface heating, which depends on a variety of surface properties, and 5) the rate of nocturnal cooling.

In the second set, we may include: 1) sea breeze convergence, 2) frequency of frontal passages, 3) frequency and strength of hurricanes, 4) frequency and duration of anti-cyclonic subsidence conditions, 5) frequency and intensity of occurrence of the trade wind inversion, and 6) the position and strength of the North Atlantic Subtropical High. The behavior of this last feature of the atmospheric circulation controls the local behavior of most of the remainder of the set.

Although it does not have an effect on the dynamics of tropospheric behavior, there is one additional feature of the atmosphere at the latitude of Alachua County which is quite important. The ozone layer here is not as thick as it is over the remainder of the United States.[3] As a result, the solar radiation in the latitude of the county is richer in ultraviolet radiation than in other parts of the United States.

The average year in Alachua County may be divided into two seasons, 1) a warm rainy season and 2) a cooler dry season. The warm rainy season runs from about the middle of May to the end of September. The cooler dry season dominates the remainder of the year. About 60 percent of the rain falls during the hot summer months, occurring as afternoon thunderstorms generated by strong surface heating, and fed by a double sea breeze convergence. Florida is not wide, and as the Atlantic and Gulf sea breezes approach each other from either side of the peninsula, they force air upwards. When high cloud cover inhibits convective development in the afternoon, permitting only the formation of small cumulus clouds, rain may occur at night as a result of instability generated by nocturnal radiative cooling from the tops of the small clouds. Precipitation during the summer has a very patchy horizontal distribution for any particular day. It is not yet known whether some areas within the county have greater average rainfall than others.

Frontal passages during the winter months are the most variable rain producing mechanism for Alachua County. Frontal or low occurrences within Florida average 38 for winter, 29 for spring, 19 for summer, and 41 for fall, for the years 1965-67 (Shaw, 1968). Shaw's winter and fall are included in the cooler dry, winter season defined above. During the winter months, the differential seasonal cooling of land and sea, the occasional presence of stagnated high pressure cells, and the formation of low level inversions by the high rate of nocturnal cooling act to maintain a high degree of atmospheric stability. A high percent-

[3]A. E. S. Green, personal communication.

age occurrence of the trade wind inversion during these winter months (70 percent in February) also contributes to this stability (Dougherty et. al., 1967). Under these conditions, convective activity is suppressed and possibilities for vertical mixing are limited. Usually the entire county will receive rain as a result of a frontal passage. The rain may occur at any time of day since frontal storms are not dependent upon local land surface heating.

Following the movement of a cold front across northern Florida, the lower troposphere will be dominated by colder air with relatively warmer air (higher potential temperature) aloft. Such a configuration is stable and acts as an additional inhibitor of vertical mixing.

Drought

A decrease in the frequency of frontal movement across northern Florida is one probable cause for periodic drought occurrence. A reduction in the frequency of frontal storms will reduce total annual precipitation substantially below annual values of evaporative demand as estimated by pan evaporation. Rain accompanying frontal storms is usually less intense than that associated with convective activity and will tend to be more effective for the recharge of soil and surface storages. On the other hand, the intensive rainfall associated with late afternoon convective storms will tend more to recharge the limestone aquifer, particularly in built-up areas where the water runs off rapidly to enter the aquifer through solution sinks. A substantial reduction in the number of frontal passages will cause extensive surface drying with concommitant vegetation stress, lowering of lake levels, and the depletion of shallow wells.

Figure 10 shows an extension of the Bermuda High across the Florida peninsula to the western shores of the Gulf of Mexico. Figure 11 shows the strong substance and atmospheric stability associated with this feature as displayed by a sounding made at the Kennedy Space Center. The broad ridge of high pressure associated with the extension has become a closed high which will most probably move northeastwards into the southern United States, or change into a high pressure ridge which may then recede eastward into the Bermuda High. Although this example is based on one occurrence for which data was available to the author, the type of atmospheric structure and its effects are typical of the presence of the Bermuda High at all seasons. The Bermuda High and associated subsidence are strongest and

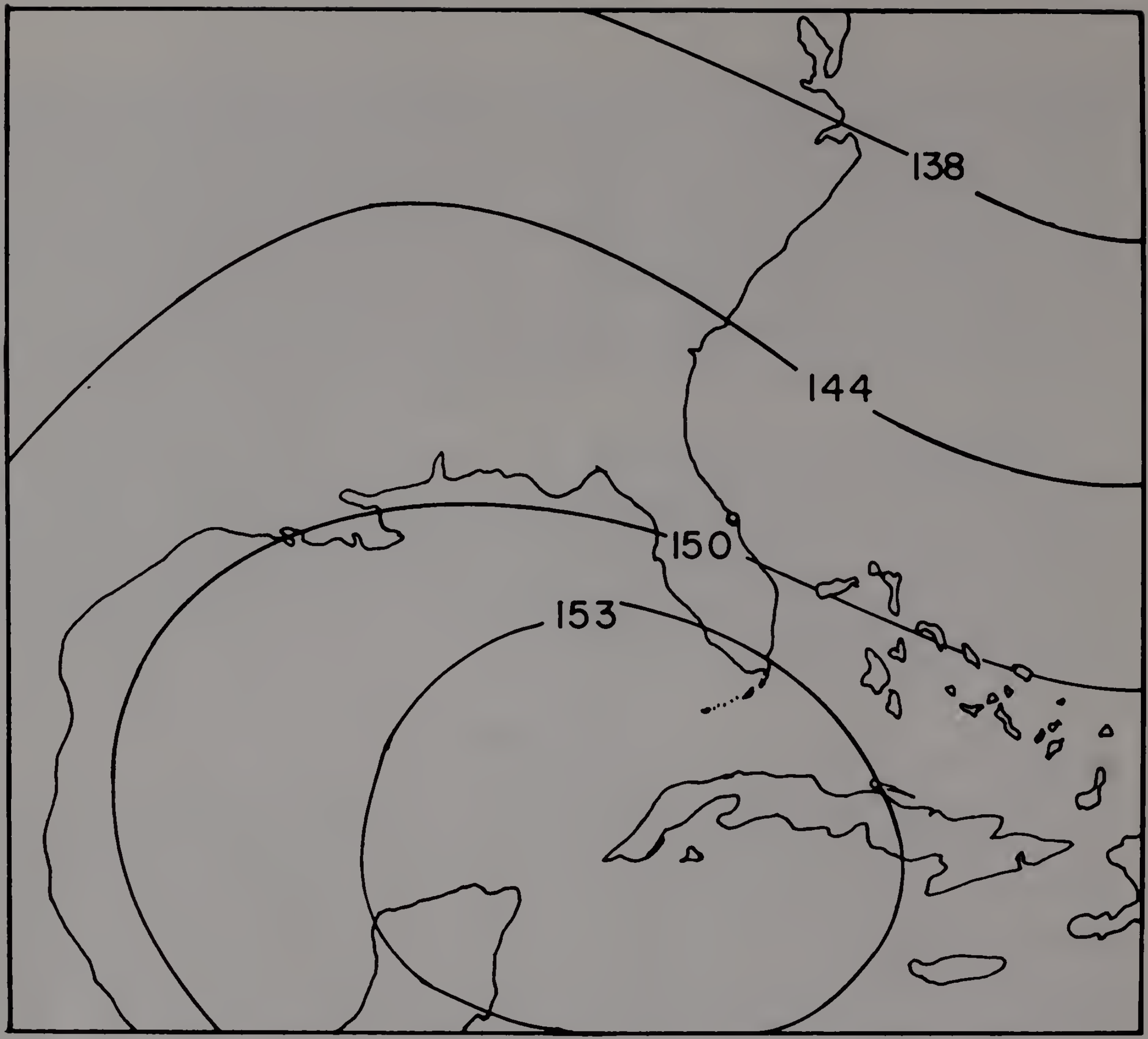

Figure 10. — Synoptic situation for 850 mb — 18 December 1974, showing an extension of the Bermuda High across the Gulf of Mexico. Contours are 10's of meters above sea level.

present most often during the winter months, and the occurrence illustrated is typical of its presence at this season.

The ridge extension of the Bermuda High is also common during the summer months (Sands, 1966), and ordinarily would induce very arid conditions within the Florida peninsula. Were it not for the intense surface heating and the presence of large bodies of warm water on either side of the peninsula, and the relative weakness of this feature during the summer months, Florida would be as arid as the great sub-tropical deserts at the same latitudes. The ocean and the Gulf provide moisture and the differential land-sea heating provides a pressure gradient for the development of sea-breeze convergence which powers intense afternoon convective storms.

A strengthening of the ridge extension and the concomitant increase in the associated stability (Fig. 11) would also act to reduce the amount of annual rainfall. This is a second mechanism which could act to cause drought conditions within the county.

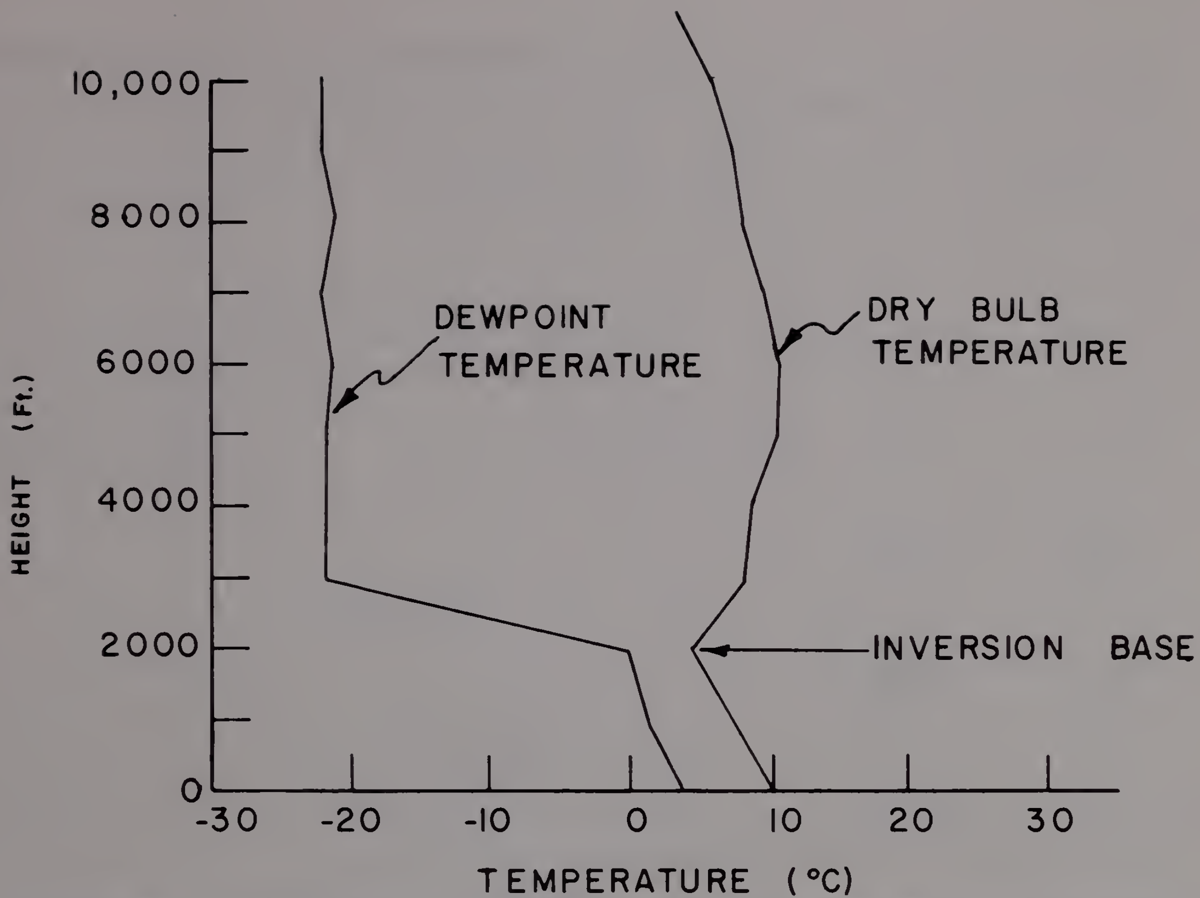

Figure 11. — Atmospheric structure associated with the synoptic situation on 18 December 1974.

Records (NOAA, 1898-1972) indicate that drought in Alachua County and in much of north Florida results from summer precipitation deficiencies. Major droughts occur on the average of once every seven years (Table 3). A drought year is normally characterized by an extended dry summer with higher temperatures than usual. Usually, maximum temperatures in Alachua County are limited by the energy used for evaporation from surfaces ordinarily well supplied with water (Priestly, 1966). As surfaces in the county dry under drought conditions, maximum temperatures rise to values well above normal. A year of major drought is often preceeded or followed by one or two years of drier than normal weather, intensifying the impact of the drought.

It is interesting to note that summer drought conditions are sometimes associated with an unusually cold winter (NOAA, 1898-1972). It has been suggested, based on floristic evidence, that Florida was drier than at present during the Wisconsin glaciation.[4] This may have resulted from the larger surface area of the peninsula during that period, or from regional atmospheric circulation patterns similar to those associated with present drought-cold occurrences.

[4]D. B. Ward, personal communication.

In addition to a possible strengthening of the subtropical high pressure system, a high located to the west of Florida, associated with a trough along the east coast extending to the Florida peninsula, could bring cold polar air south. This is simi-

Table 3.—Timing of Drought Occurrence.

Year	Severity	Intervals Between Occurrences: Years between each occurrence		Years between severe occurrences
1898	weak			
1899	severe			
		6	1899-1906	6
1906	severe			
1907	severe			
1908	severe			
		5		
1914	weak		1908-1917	8
1915	weak			
		1		
1917	severe			
1918	weak		1917-1923	5
		4		
1923	severe			
		1		
1925	weak		1923-1927	3
		1		
1927	severe			
		3	1927-1931	3
1931	severe			
1932	severe			
1933	weak		1932-1943	10
		9		
1943	severe			
1944	weak		1943-1954	10
		9		
1954	severe			
1955	severe			
		5		
1961	weak		1955-1963	7
		1		
1963	severe			
		2		
1966	weak			
		4	1963-1971	12
1971	weak			
		4		
1976	severe	—		—
	Average Interval	3.93 years		7.11 years

lar to the 'smog chute' discussed later. A mechanism of this form, when coupled with increasing frequency of continental polar air mass movement across the plains, might well act to decrease the effect of frontal precipitation while maintaining cold, clear air over the peninsula. Increased frequency of cold air mass movement southwards during the winter, associated with anticyclonic circulation aloft over the southeast during the summer, would give the drought-cold associations observed. To my knowledge, this association of circulation patterns has not been demonstrated; it remains an hypothesis to be tested.

Summer rains have a very fortunate cooling effect in the afternoons. Two mechanisms contribute to this effect. The afternoon storm clouds act to screen the surface from solar radiation, and there are also downdrafts of cold air from the storms. Although most of the water which falls on the county during the summer comes from the Atlantic Ocean or the Gulf of Mexico, Alachua County, situated as it is, inland in the northern part of the state, does not experience strong temperature modification effects from either body of water.

Although Alachua County may be expected to experience hurricane force winds only rarely (winds causing structural damage have occurred between 10 and 15 times in 55 years) (Bradley, 1972), hurricanes in the proximity of the Florida peninsula will usually produce rain in the county. Percent frequencies of tornados and other intense local storm occurrences are unknown.

As a result of nocturnal radiative cooling, ground fogs may form in the late evenings during the winter months. These fogs will usually last into the early morning, only rarely persisting into the afternoon. The top of the ground fog marks the bottom of the temperature inversion produced by the nocturnal radiation loss. Early morning temperature inversions are especially frequent and may act as effective concentrating mechanisms for local nighttime pollution emissions.

CURRENT PROBLEMS OF APPLIED CLIMATOLOGY

Health

Because of the increased ultraviolet radiation at the latitude of Florida, the probability of skin cancer resulting from prolonged exposure to the sun is higher here than elsewhere in the nation.

Alachua County has three periods of peak pollen activity, which may be quite unpleasant for sufferers from hayfever and

similar respiratory ailments. These periods are: 1) January-February, 2) April-May, and 3) July-September. Not only is the third period the longest, but pollen concentrations are higest at this time (Wittig, 1971).

There are usually several days every summer in Alachua County when high temperatures, high humidities, and intense solar radiation create conditions which are severely stressful to both humans and animals. Such conditions may be particularly serious for the ill, aged, or pregnant. Any heavy outdoor labor should be avoided at these times. Unfortunately, cooling degree day data are not available.

Pollution

The Florida Department of Pollution Control (1974) has estimated that by 1985 ambient particulate levels for Gainesville will be in violation of the 24-hour concentrations of the state ambient air standard and average annual concentrations of both state and federal ambient air quality standards (Table 2). Environmental Science and Engineering, Inc. have completed a model simulation study of air quality in Alachua County for the RUB. This study has been referenced earlier. The ICAAS Caper project in 1971 measured concentrations for particulates SO_2, NO_2 and total oxidents in the Gainesville area.

The Regional Design Studio has mapped air pollution sources for the county from aerial photographs and from an aerial reconnaissance. The resulting map (not shown) shows that while the most severe sources appear to be point sources, most of the visual deterioration of air quality is due to internal combustion emissions from area sources. The largest area source is provided by traffic loads in the Gainesville area. From these area sources, pollution concentrations will vary in strength during the day, displaying peak values during hours of heavy traffic. Emission and concentration patterns will change at these times, extending out away from Gainesville along commuter routes.

Another mechanism postulated by Gerrish (1972) not only acts to concentrate pollutants, but may also serve to bring pollutants into the county from distant sources. Gerrish terms this mechanism a 'smog chute.'

> In a smog chute, the persistent and perhaps convergent flow from the north establishes an inversion at middle levels of the atmosphere over Florida. This inversion acts as a lid prohibiting dispersion upwards [Fig. 12]. Such inversions aloft are common with this type of flow pattern. The sinking and mixing of the air

below the inversion aloft would be confined to the peninsula by the sea breezes blowing inland from both coasts. Thus the geography of Florida helps to establish a unique atmospheric funnel for carrying possible pollutants from north of Florida down into our state.

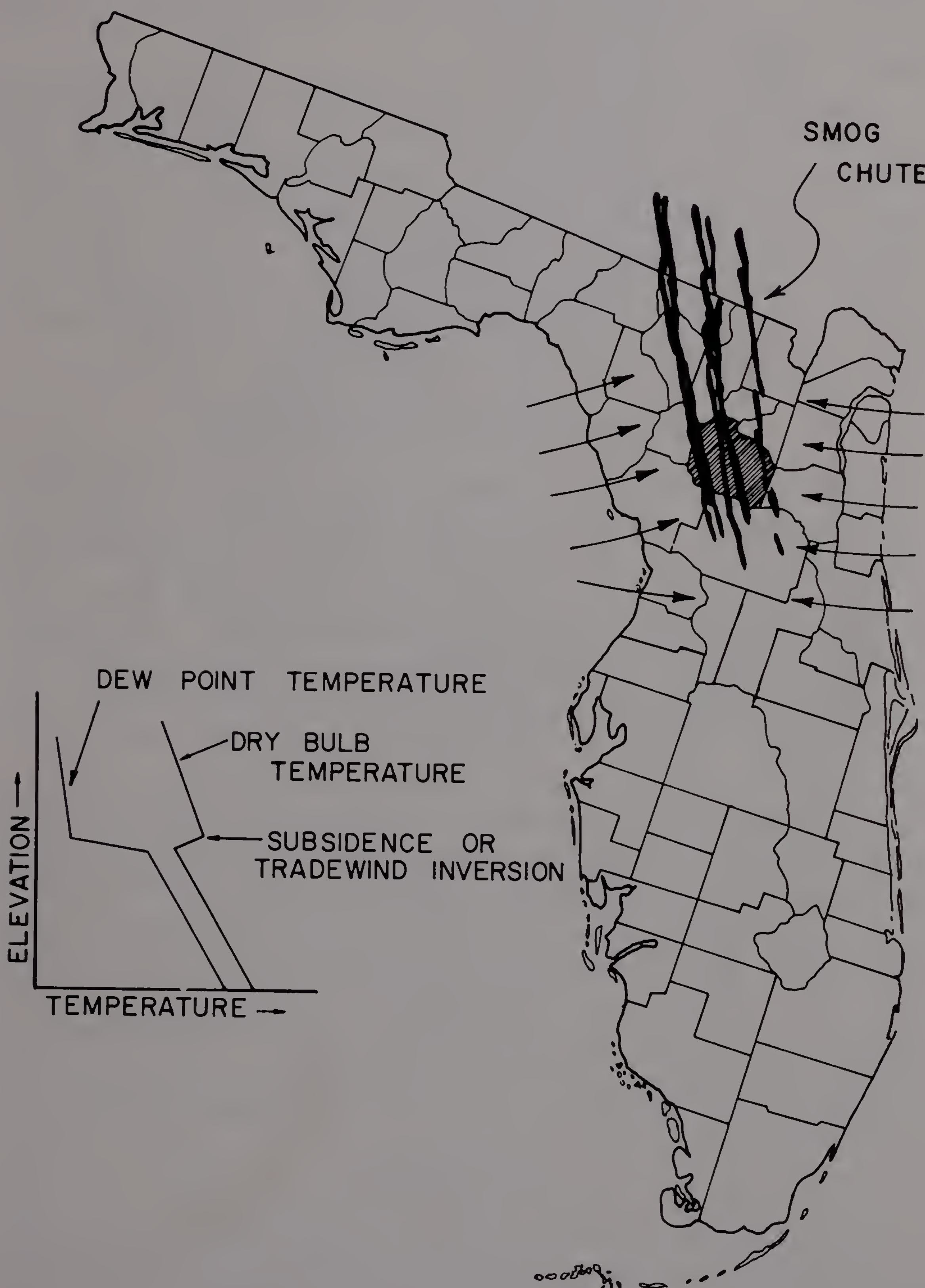

Figure 12. — Pollution concentration by convergence. The inset diagram shows the vertical atmospheric structure associated with this process.

Alachua County is located in the center of the state and could be quite susceptible to such incidents. Fumes from pulp mill operations at Palatka or Perry may infrequently be detected by the inhabitants of Gainesville. Although Palatka is 42 miles to the east and Perry is 84 miles to the west, the fumes are still evident and objectionable upon the rare occasions that they reach Gainesville.

There is a general feeling within Florida that meteorological conditions in the state are particularly favorable for the dispersion of air pollution and the maintenance of excellent air quality. This idea has been given formal support in the *1972 State of Florida Air Implementation Plan.* In spite of this, I am forced to conclude that Alachua Couny owed its relatively clean air to a paucity of emission sources, not to any particularly favorable meteorological circumstances.

Computer Modeling of Topoclimate

Using the Dynaspace computer model of land use patterns of Alachua County, a map of the spatial distribution of eight patterns of temperature behavior was generated (Dohrenwend and Wetterquist, 1977), One of the most striking features of the resultant topoclimatic map was the prediction of a 'heat island' around the city of Gainesville (Fig. 13). Ground measurements confirmed the existence of this heat island, and its pattern seems to correspond closely to that predicted by the computer. The strength of the heat island effect was about 3°C.

The Dynaspace model has also been used to generate a first order model of air pollution patterns within the county. Although this model needs quantitative verification, the predicted patterns have been confirmed by aerial observations. This model demonstrates that the two major present sources are automobile emissions and electric power generation. As it continues to be calibrated and improved, the Dynaspace model is becoming an increasingly powerful tool for an examination of the effects of changing land use patterns on local climate and air quality.

DISCUSSION

The material above is largely descriptive in nature, and is presented in the hope that it will provide a useful summary of the climatic behavior of Alachua County. Because of the multiplicity and obscurity of data sources, it is often very difficult to acquire a useful picture of the overall climatic behavior in a restricted area the size of a county. An understanding of local

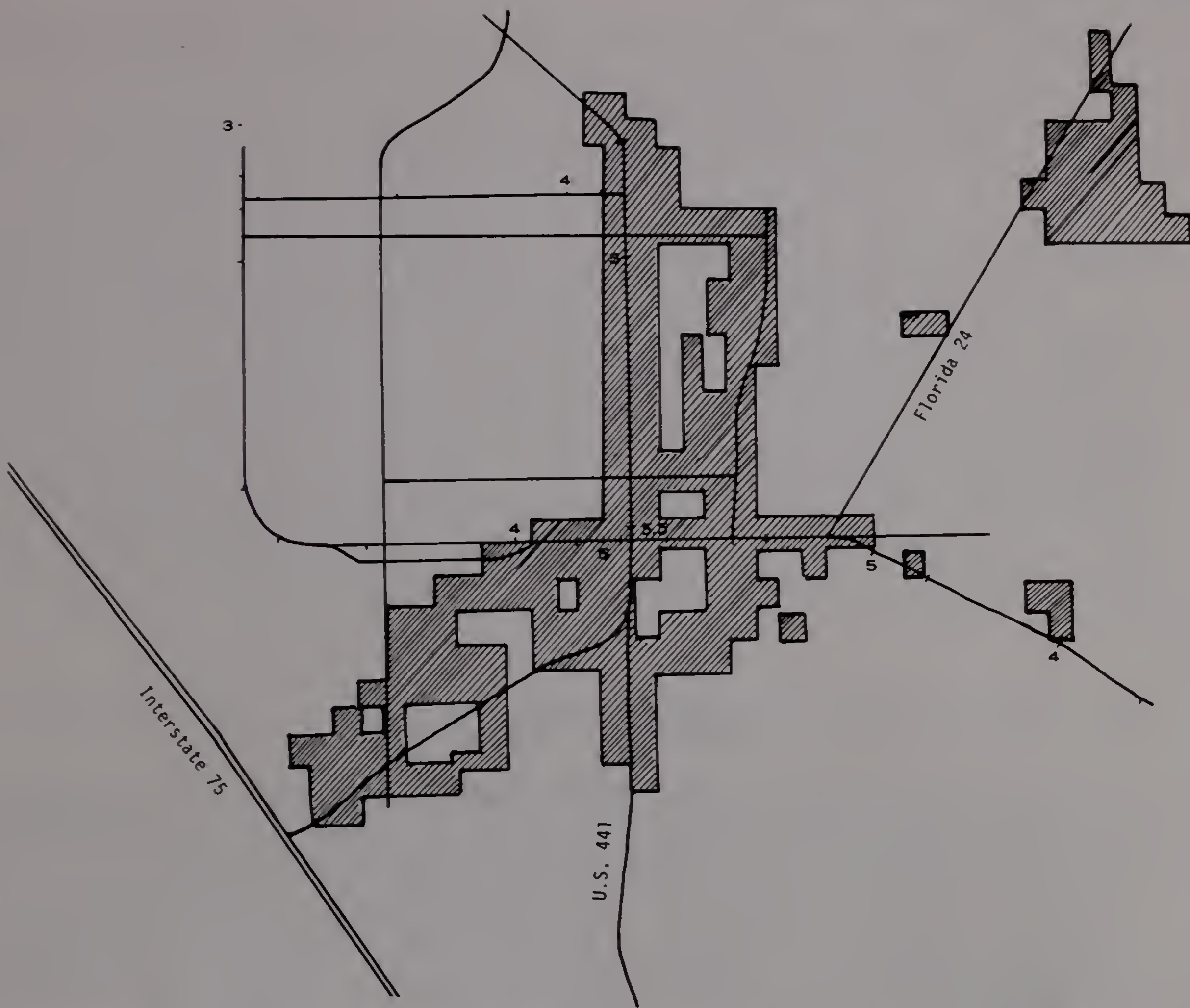

Figure 13. — Computer predicted heat island for the Gainesville area. Numbers on the diagram refer to temperature observations in °C. The measured 4.5°C isotherm shows close agreement with the predicted maximum temperature effect (shaded area).

climatic patterns is frequently crucial to the success of agricultural and environmental studies, an important consideration since the University of Florida is located at Gainesville. In addition, the data presented provide a base for practical applications in the fields of air pollution control, agriculture, regional land use planning, and public health.

In addition to the material presented, some studies of other aspects of the local climate are currently in progress. The Regional Design Studio is presently generating predictive maps of topoclimate as responses to different land use planning strategies. The Regional Design Studio is also working on a model to generate predictive maps of regional air quality patterns. Dr. J. Bartholic of the Fruit Crops Department is currently working on different aspects of freeze protection. Dr. A. E. Green and his Interdisciplinary Center for Aeronomy and Other Atmospheric Sciences are continuously developing research involving a variety of problems concerning local atmospheric conditions.

Work is being initiated on the chemical quality of precipitation and dry atmospheric deposition.

Before we can describe the local climate of a region the size of Alachua County in really adequate detail, much work remains to be done. A detailed study of the coupling between local variations in climatic elements and changing synoptic patterns would be a valuable contribution. Research on the spatial distributions of the different climatic elements and their relationships to local topography should be continued. For example, a study of rainfall distribution within the county would be quite valuable. Ultimately, Alachua County could act as a natural laboratory for the development of ideas for the general prediction of local climatic behavior.

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